

ISDN product overview

What is ISDN?

Integrated Services Digital Network (ISDN) is a set of recommendations developed by the International Telegraph and Telephone Consultative Committee (CCITT). These recommendations form a standard in digital communications, providing digital interfaces between telephones, terminals, and telecommunications networks.

ISDN uses a single transport to carry multiple information types. What once required separate networks for voice, data, images, or video conferencing is now combined onto one common high-speed transport.

User voice and data information is carried over bearer channels, or B-channels. The standard signaling protocol is transmitted over a dedicated data channel called the D-channel. The D-channel carries call setup and feature activation information to the destination.

ISDN and the Meridian 1 environment

Meridian networking supplements the currently defined CCITT ISDN recommendations with network functions, like alternate route selection, private numbering plans, class of service, and network access security. Also, Meridian networking extends the CCITT ISDN network functions defined for the interface to public ISDN connections into the private network environment.

Network interfaces

The initial step in building a network is to define the network interfaces that physically and logically connect the switches in the network.

A network interface is physically composed of a collection of trunks, each of which carries signaling and/or user data information. Trunks are transmission channels that carry voice and data traffic, together with signaling information, between switching systems in the network.

Trunks can be classified based on two parameters:

- the type(s) of service supported on the trunk
- the nature of the signal that is transmitted on the trunk, either digital or analog

There are a number of trunk types classified by the type of service they can provide. For example:

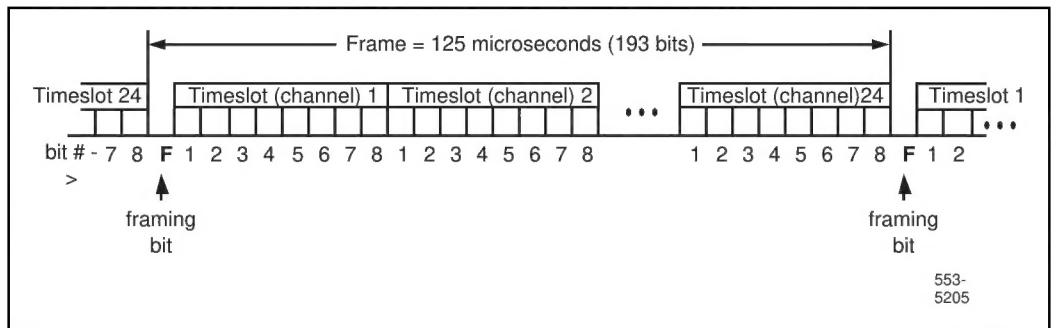
- PBX-to-Public Exchange trunks (also referred to as central office trunks or COTs) provide public switched telephone service to the PBX.
- TIE trunks connect PBXs directly without being switched at the intermediate Public Exchange(s) (although they can be).
- Foreign Exchange (FX) trunks provide the PBX with the equivalent of a local connection to a “foreign” or distant Public Exchange, bypassing switching at the local Public Exchange.
- Wide Area Telecommunications Services (WATS) trunks permit the PBX to receive (INWATS or “800” service) or originate (OUTWATS) long-distance calls at a lower rate than regular long distance service, based on a bulk pricing arrangement with the long distance service provider.
- Direct Inward Dial (DID) trunks provide a portion of the called party’s number, signaled from the local Public Exchange to the PBX, enabling the call to be delivered without private network attendant intervention.

Note: Due to CCITT regulations, any DID/COT connection by means of ISDN is two-way. There is no distinction between the two trunk types. The central office views them as public trunks and will not throttle.

Analog trunks are provided on voice-frequency (VF) facilities that operate in either a 2-wire or 4-wire transmission mode. In the 2-wire mode, both transmit and receive signals are carried on the same pair of wires. Four-wire mode uses separate wire pairs for each direction of transmission. The information-bearing capability of these trunks is sufficient to support speech or voice-grade data. A voice-grade channel is one with sufficient bandwidth to pass an analog voice signal, or approximately 3.1 kilohertz (kHz). Voice-grade data is a data signal that can be successfully passed through the same 3.1 kHz channel (for example, a modem).

A digital trunk is a 56 kbps data channel that can carry either voice or data information. In North America and some other international countries, the digital trunk is carried on the T-1 digital transmission facility. The T-1 carrier has a data rate of 1.544 Mbps and can support up to 24 digital trunks. The digital trunk signal transmitted on these carriers is represented by a sequence of 8-bit digital words. Each word occupies one channel (called a “timeslot”) in a larger structure called a “frame.” The frame structure of the T-1 carrier’s signal is shown in Figure 1.

Figure 1
The frame structure of the T-1 digital carrier (from CCITT G.704)

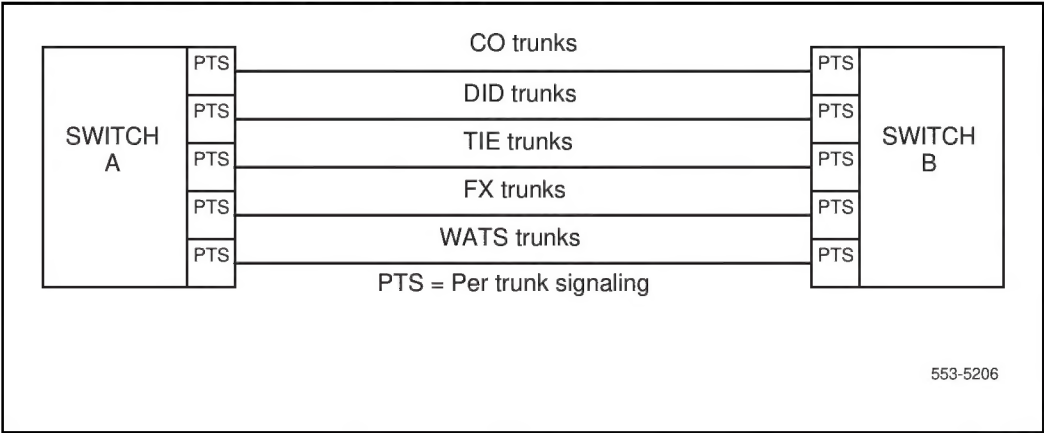


Signaling

Trunks provide the communication channels for the network interface; signaling permits these channels to be used effectively. Signaling is the process of transferring information between two or more switches of a communications network in order to control the establishment of connections and related operations.

Each trunk type (CO, TIE, FX, WATS, DID) requires its own particular form of signaling (loop start, 2-wire duplex, 4-wire duplex, E and M 2-wire, E and M 4-wire, loop dial repeating). Pre-ISDN trunks (that is, analog or digital) carry this signaling information together with the user's information. This scheme, illustrated in Figure 2, is commonly referred to as per trunk signaling (PTS), or in-band signaling.

Figure 2
A functional view of per trunk signaling



Meridian networking uses ISDN's common channel signaling capability to replace per trunk signaling with an out-of-band computer-to-computer signaling channel, which carries the signaling information for a number of trunks. This concept is illustrated in Figure 3.

Primary Rate Interface (PRI) integrates the signaling requirements of all the public exchange trunk types. Meridian networking supports this functionality, as illustrated in Figure 4. This is referred to as out-of-band signaling.

Figure 3
A functional view of ISDN's common channel signaling capability

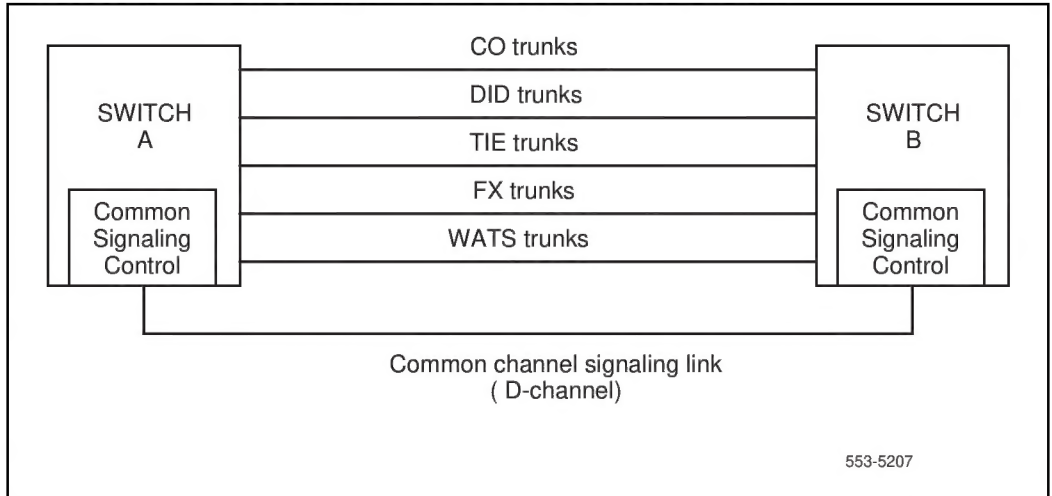
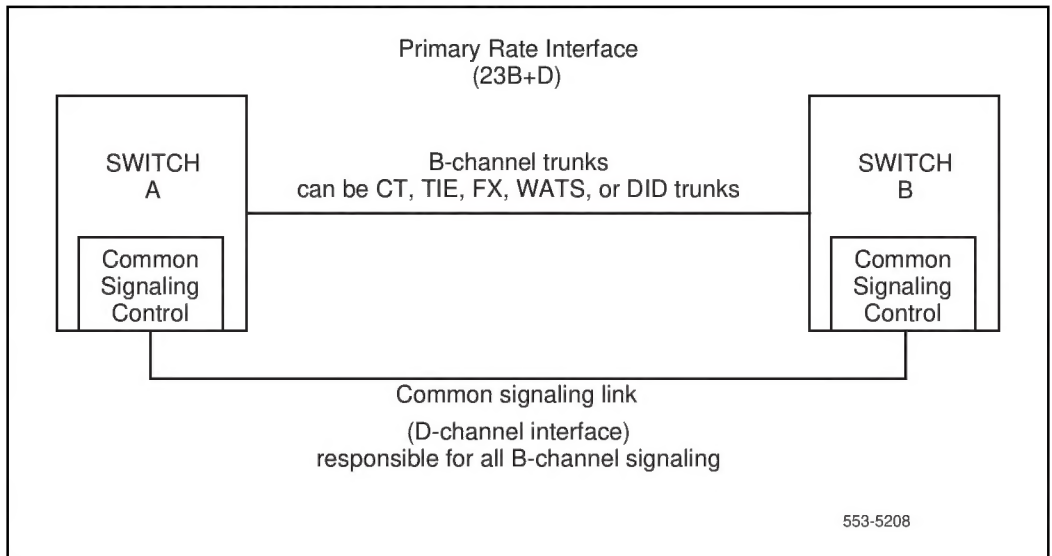


Figure 4
ISDN PRI's common channel signaling capability



Signaling protocols

Signaling protocols govern the format, timing, sequencing, and control of the exchange of signaling information between switches in the network.

Meridian networking uses the ISDN D-channel, out-of-band signaling protocols as defined by CCITT. These protocols are based on a model containing seven layers that was developed by the International Standards Organization (ISO). This seven-layer model, called the Open Systems Interconnection (OSI) model, was adopted by the CCITT and used as the basis for building sets of protocols for ISDN.

A detailed description of the OSI model and how it is applied in the Meridian networking signaling system is found in Appendix 1 of the *Meridian Networking Feature Document* (P0803833).

Types of ISDN network interface

Meridian networking currently supports three forms of ISDN network interface:

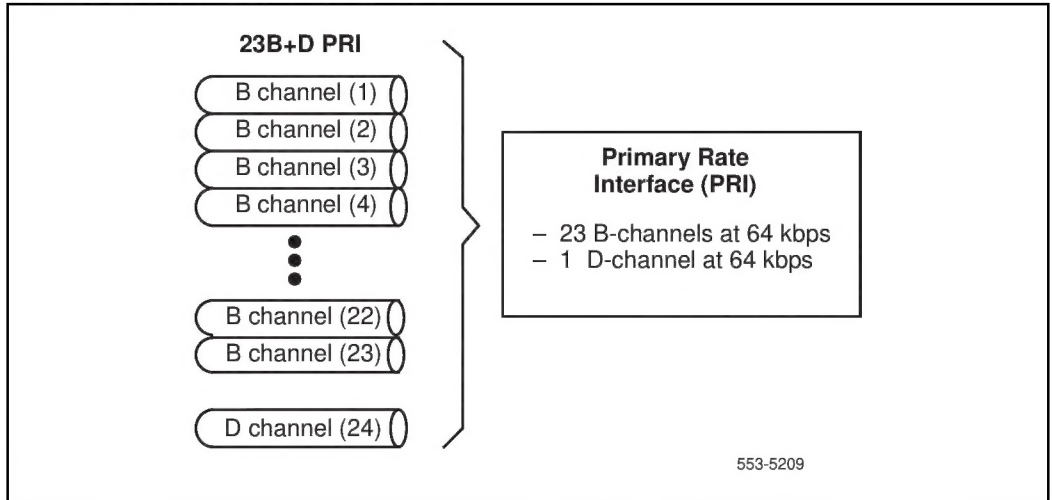
- Primary Rate Interface (PRI 23B+D)
- nB+D Primary Rate Interface (nonassociated signaling)
- ISDN Signaling Link (ISL) interface

Primary Rate Interface (PRI 23B+D)

The Primary Rate Interface (PRI) is structured as a collection of 24 digital, 56 kbps/64 kbps channels. One of these channels is used to carry the D-channel signaling information. The other channels are for user voice and data transport and are referred to as bearer channels, or B-channels.

The physical (layer 1) specification for the PRI is defined in CCITT Recommendation I.431. This specification supports the standard electrical characteristics and frame structures of the 1.544 Mbps T-1 digital carrier. PRI can therefore only support up to 23 B-channels and one D-channel. Figure 5 shows the PRI structure.

Figure 5
Primary Rate Interface structures



nB+D Primary Rate Interface (nonassociated signaling)

Although the CCITT currently specifies the PRI layer 1 protocol for 23B+D interface structures, CCITT layer 3 (Q.931) supports the D-channel messages for call setup, feature activation, and call tear down. Meridian networking can also support a feature called nonassociated signaling (nB+D). In this configuration, one active D-channel can provide signaling support for all the B-channels contained on up to 16 digital carriers. This translates to support for 382 B-channels and one D-channel and one backup D-channel with T-1 carriers. Figure 6 shows an nB+D PRI structure.

ISDN Signaling Link (ISL) interface

The CCITT currently limits the layer 1 ISDN protocols to digital facilities only. Analog facilities can meet some customer applications more effectively. Meridian networking offers this flexibility in the form of the ISDN Signaling Link (ISL) interface.

The ISL interface is a configuration unique to Meridian networking for Meridian 1 to Meridian 1 systems. It extends the advantages of ISDN signaling to locations served by analog or digital facilities. The ISL interface can contain analog and/or digital trunks. The signaling information is carried on one of these trunks, called the ISDN Signaling Link, which is a D-channel. The other trunks are for user voice and data transport.

The signaling connection is a separate or synchronous data circuit, which can be established over a leased line, or an existing trunk circuit using standard data communications equipment (DCE) interfaces (such as modems, multiplexers, or Meridian 1 data adapters). In the case of a failure on this link, signaling operation reverts to conventional, per trunk signaling.

The ISL interface structure is illustrated in Figure 7. For more information on ISL, see “ISDN Signaling Link” on page 363.

ISL modes of operation

There are two modes of ISL operation: shared and dedicated.

Shared mode requires a PRI (either 23B+D or nB+D) between originating and terminating Meridian 1 systems. The ISDN D-channel is used as the vehicle to provide out-of-band signaling for the non-ISDN trunks. Since the PRI D-channel is shared between the PRI B-channels and the analog/digital trunks, this ISL configuration is called shared mode.

Dedicated mode is appropriate when no PRI exists between originating and terminating Meridian 1 systems or when it is not desirable to share an ISDN D-channel as described above. A dedicated signaling link (ISL) is established between originating and terminating Meridian 1 systems. The signaling information for the selected, analog/digital ISDN trunks is transported over the ISDN signaling link.

Figure 6
An example of the nB+D Primary Rate Interface structure

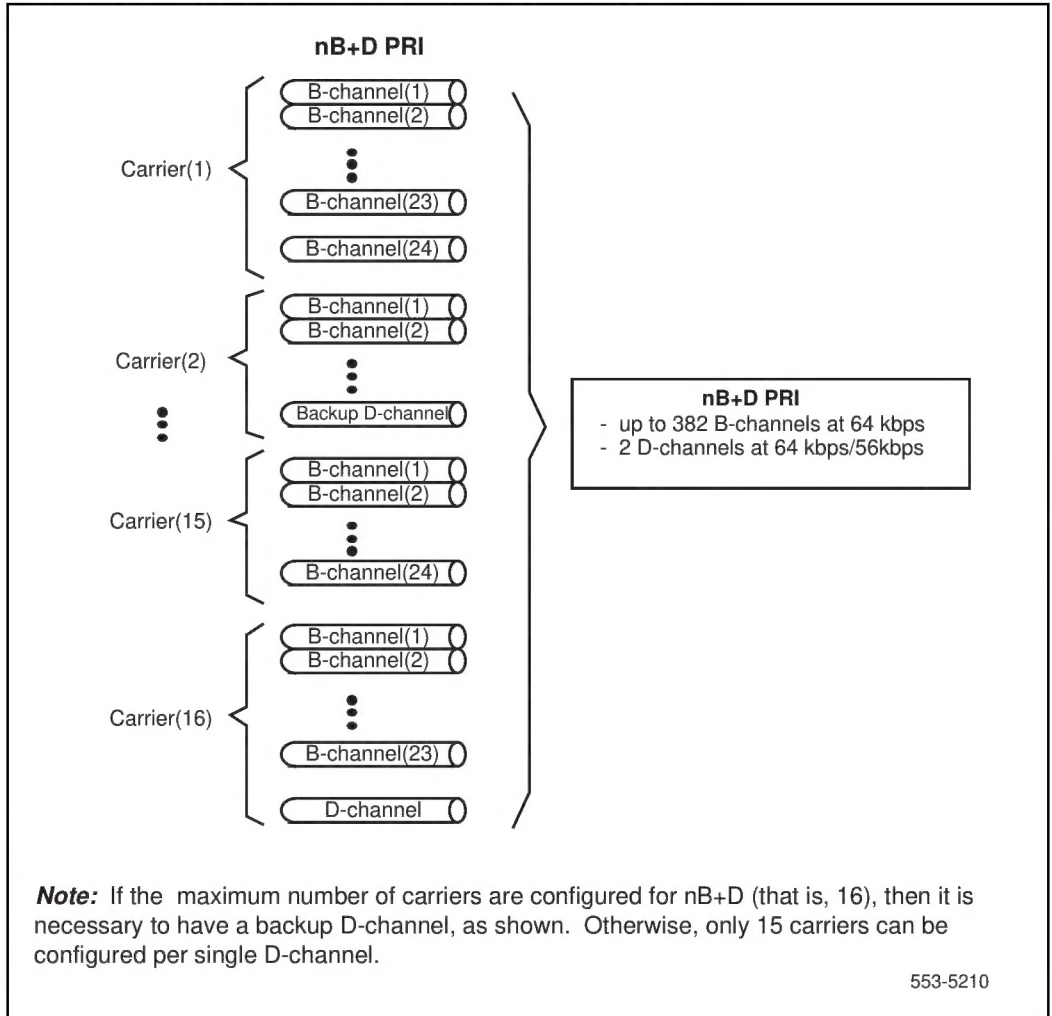
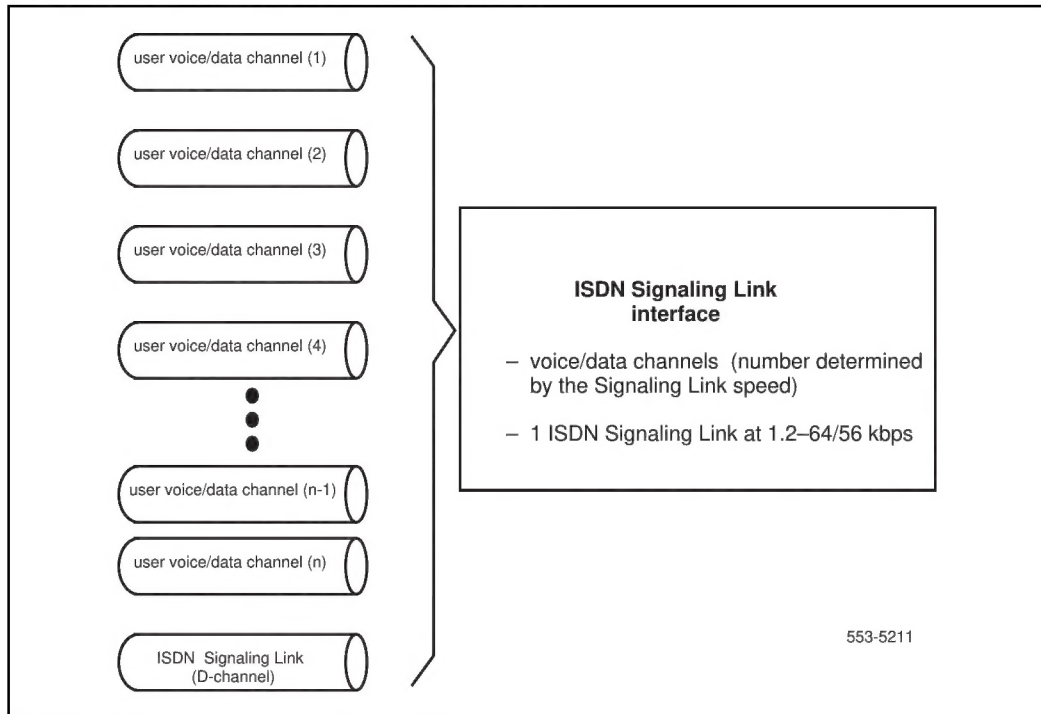


Figure 7
ISDN Signaling Link (ISL) interface structure



Backup D-channel

The signaling reliability on each of these ISDN network interfaces can be enhanced by adding the backup D-channel function.

In situations where the reliability of the D-channel signaling is critical, each of the PRI and the nB+D PRI interfaces can be configured to use one active and one backup D-channel. If the active D-channel fails, then D-channel processing switches to the backup D-channel. When dealing with standard 23B+D PRI structures, it is necessary to have at least two T-1 spans in order to provide a backup D-channel. Figure 6 shows a backup D-channel configuration. (Configuration of backup D-channel is shown in “Configuring PRI” on page 31. For a more detailed description of the backup D-channel, see “Backup D-channel” on page 125.)

Integrated Trunk Access

Integrated Trunk Access (ITA) allows in-band A and B bit signaling trunks and out-of-band common channel signaling trunks to share the same digital carrier. ITA provides trunking efficiency when accessing a mix of ISDN and non-ISDN services from a Meridian 1 or an ITA-compatible public exchange switch (such as DMS-100).

Integrated Services Access

Integrated Services Access (ISA) allows different service or trunk types to be routed over any B-channel, on a call-by-call basis, rather than dedicating each B-channel to a specific service or trunk type. This is referred to as dynamic allocation of B-channels.

Trunk type or service designation is made by means of the Network Specific Facilities information element in the call setup message. ISA service routes are configured through service change. An ISA master route contains a list of B-channels that can be shared. Different service route types, such as WATS, DID/CO, Foreign Exchange (FX), and TIE, are then created and associated with an ISA service route. These service routes are not allowed to have private B-channel members.

Note: Due to CCITT regulations, any DID/COT connection by means of ISDN is two-way. There is no distinction between the two trunk types. The central office views them as public trunks and will not throttle.

The number of simultaneous calls using an ISA route can be controlled by defining a maximum threshold for calls allowed for each service route type. Also, a minimum threshold can be defined for the number of B-channels that are ready for use by a service route. For a more detailed description of ISA, see “Integrated Services Access” on page 341.